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DURUM WHEAT.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,

Washington, D. C., March 11, 1913.

SIR: I have the honor to transmit and to recommend for publication as a Farmers' Bulletin the accompanying manuscript, entitled "Durum Wheat," prepared by Messrs. Cecil Salmon, Plant Physiologist, and J. Allen Clark, Scientific Assistant, under the direction of Mr. Carleton R. Ball, Acting Cerealist in Charge of Cereal Investigations.

This wheat is one of the valuable plant introductions made by the Department of Agriculture. Its productiveness and resistance to drought and disease have made it a popular wheat in the semiarid plains, while its value for making flour and macaroni has finally overcome the early opposition of the milling trade and the prejudice of buyers.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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DURUM WHEAT.

INTRODUCTION.

As far as known, the first introduction of Russian durum wheat into the United States was by the Department of Agriculture in 1864. This and later introductions were tested under humid conditions, which resulted in a poor quality of grain, and they soon disappeared from cultivation.

The beginning of the durum-wheat industry in this country was made in 1898, when Mr. Mark Alfred Carleton, Cerealist of the Department, went to Russia in search of drought-resistant cereals for the dry lands of the West. This search was resumed in 1900. Many varieties of durum wheat were obtained, among them the Kubanka, which has proved so well adapted to the northern Great Plains area. The new introductions soon became popular among the farmers of that section, but the milling trade strongly opposed the grain on account of the difficulty of milling and the belief that durum wheat was of value only for the making of macaroni and similar products.

Production increased so rapidly, however, jumping from 60,000 or 70,000 bushels in 1901 to about 6,000,000 or 7,000,000 bushels in 1903, and probably about 50,000,000 bushels in 1906, that the development of the market did not keep pace with the increased production. For this reason the price, which had always been below that of common wheat, dropped to even lower levels, the difference sometimes amounting to 20 or 25 cents a bushel. This low price so discouraged the growers that the production in 1909 was slightly less than 40,000,000 bushels. Severe drought reduced the quantity produced to 24,000,000 bushels in 1910 and 16,000,000 in 1911. In 1912 the production was again normal at about 40,000,000 bushels.

CHARACTERISTICS.

Botanically, durum wheat (*Triticum durum*) is very closely related to the common wheats which comprise the principal wheat crop of this country. The durum varieties are all spring wheats, at least so far as known. It has been possible to grow some of them as winter

varieties at the Amarillo Cereal Field Station in Texas, at the Nephi substation in Utah, and at southern field stations. When thus fall sown, none of them has proved equal to the standard winter common wheats.

Durum wheat differs from the other spring wheats in size and character of both plant and grain. The plant is usually taller and more vigorous than common wheat, has wider leaves, and generally matures earlier. The heads are broader and more compact, and are often shorter. The beards of durum wheat are exceptionally long and stiff, which, with the shape and compactness of the head, give the plant much the appearance of barley, for which it is often mistaken by those not familiar with the crop. The grains are large and, as indicated by the name "durum," are very hard. The usual color of the grain is clear amber as contrasted with the reddish color of the spring and winter common wheats. There are, of course, wide variations between different varieties in the size, shape, color, and general appearance of both plant and grain. The varieties in general cultivation (Kubanka and Arnautka) have smooth yellowish chaff and yellowish beards and clear amber kernels. Others have black chaff and black beards; the chaff may be smooth (Black Don) or velvety (Velvet Don). There are also numerous forms between these yellow and black groups, and still others with white chaff and white beards.

The durum wheats are less subject to smut and rust and are more drought resistant than the spring common wheats. On the other hand, the quality of the grain is lowered when grown in humid areas or in seasons that are abnormally wet. The compactness of the head prevents rapid drying after rains or heavy dews, which makes durum wheat more subject to attacks of scab in damp, rainy weather.

The advantage most often claimed for durum wheat is its drought resistance. Having been grown apparently for many centuries subject to severe droughts, it has developed those qualities which make it admirably fitted for such conditions. Durum wheat owes its value for areas of low rainfall to its rapid, vigorous growth, early maturity, resistance to drought and disease, and resulting productiveness. On the other hand, the long, stiff beards are such a source of discomfort in handling that many farmers object to the crop.

VARIETIES.

The Department of Agriculture has introduced and tested a large number of varieties of durum wheat. These have been received under 70 or 80 different names and include more than 200 separate importations. These have been tested either independently or in cooperation with the State experiment stations.

KUBANKA AND ARNAUTKA THE LEADING VARIETIES.

The Russian varieties, Kubanka and Arnautka (fig. 1), have proved generally superior to all others. The Kubanka has proved especially well adapted to the drier western portions of the northern Great Plains area, while the Arnautka has proved best adapted to the more humid eastern portion of the same area. Tests conducted at the State experiment stations at Brookings, S. Dak., Fargo, N. Dak., and at the Edgeley and Langdon substations in North Dakota all show the superiority of the Arnautka variety for the eastern parts of these



FIG. 1.—Heads of the (1) Kubanka and (2) Arnautka varieties of durum wheat.

States and for the adjacent portion of Minnesota. On the other hand, tests conducted at substations in the central and western portions of the Dakotas show an equal superiority for the Kubanka. These varieties have proved excellent yielders also in northeastern Colorado and in the Judith Basin of Montana, though closely related varieties, such as Beloturka, Yellow Gharnovka, and Pererodka, have so far slightly exceeded them in yield.

An interesting and important relationship seems to exist between the adaptation of these varieties in the United States and in the Russian provinces from which they were imported. In Russia the Ar-

nautka variety is largely grown only in the territory bordering the Sea of Azov and extends only a short distance outward therefrom.¹ The rainfall near the seacoast is about 20 inches annually, varying in different localities and decreasing rapidly toward the interior. Beyond this narrow strip the climate is drier and the conditions on the whole much more severe. In this interior region the Kubanka is generally grown and is a more satisfactory variety.

The rainfall of the eastern portion of North Dakota and South Dakota, where the Arnautka wheat has given the best results, is practically the same as that of the territory bordering the Sea of Azov. Westward in the Dakotas the rainfall decreases as it does outward from the Sea of Azov, and here, as in Russia, the Kubanka variety has proved superior.

The Kubanka and Arnautka varieties are very similar in appearance. Both have long yellowish beards and smooth yellow chaff. The grain of both is of a clear amber color and very hard. The heads of the Kubanka are shorter and broader (see fig. 1), and the grain is usually shorter and plumper. It is difficult to distinguish between the two varieties unless they are grown side by side, the influence of different environments often obliterating varietal differences. The differences in appearance of the Kubanka and Arnautka varieties are so small that about the only way a farmer can be certain of getting the one he wants is to obtain seed from his State experiment station or some other reliable source. The Arnautka variety is usually more rust resistant than the Kubanka, which may account for its higher yields in eastern North Dakota and South Dakota, where rainfall and rust infection are greater than farther west.

AREA TO WHICH ADAPTED.

According to the census of 1910, 87.5 per cent of the durum wheat produced in the United States in 1909 was raised in North Dakota and South Dakota, and probably about the same proportion holds true for 1910, 1911, and 1912 (fig. 2). Minnesota ranks third in production, with about 7 per cent of the total crop. Practically all of the remaining 5 or 6 per cent is grown in Nebraska, Kansas, Colorado, Wyoming, and Montana.

CHIEF PRODUCING AREA.

The area of greatest production is in southeastern North Dakota and northeastern South Dakota, extending slightly into Minnesota. Durum wheat was first extensively tested and distributed in the area

¹ Carleton, M. A. Macaroni wheats. U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 3, 1901, pp. 11, 12.

where it is now most largely grown. The farmers of this section became acquainted with its value and continued growing it when others refused because of the lower price offered for durum wheat. A second area of smaller extent and much smaller production includes northwestern Kansas, northeastern Colorado, southeastern Wyoming, and western Nebraska. In other portions of Wyoming and also in

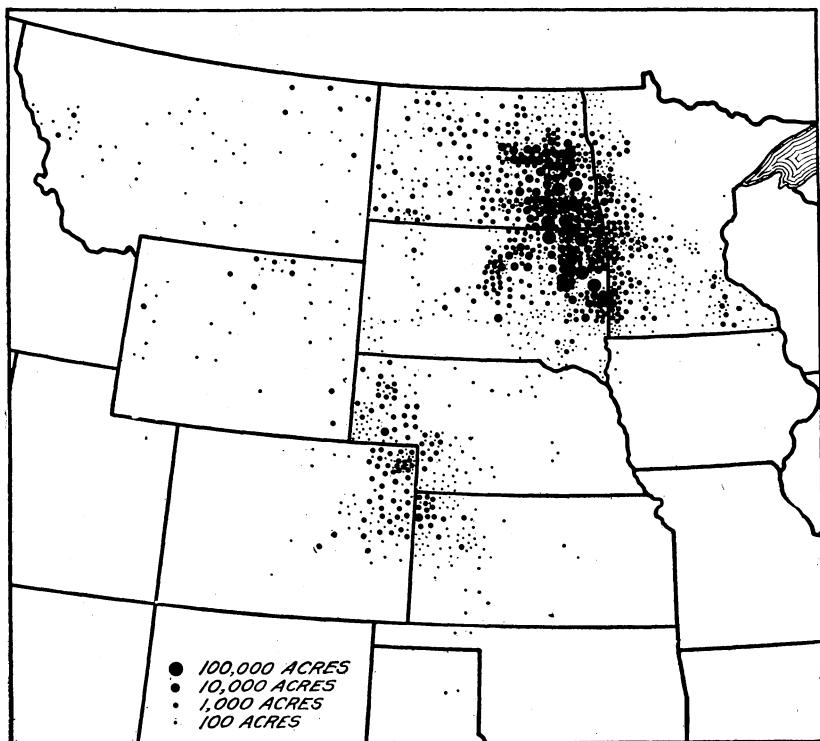


FIG. 2.—Map of a portion of the United States showing the acreage of durum wheat in 1909, as reported by the census of 1910.

Montana there are certain districts where a considerable part of the wheat grown is durum.

FACTORS AFFECTING INCREASE IN AREA.

In the western portion of the Great Plains area, from western South Dakota and adjacent Montana south to the Panhandle of Texas, durum wheat comes into competition with both winter and spring common wheats. The results so far obtained show that wherever winter wheat can be successfully grown it is more satisfactory than any spring wheat. The introduction of hardier varieties and a better understanding of the cultural requirements of winter wheat have permitted growing it in areas formerly thought entirely unsuited to

its production. In many cases it has almost entirely supplanted spring wheat. In this portion of the Great Plains area, therefore, winter and spring wheat are contending for supremacy, with the advantage in favor of winter wheat. It is also an area in the process of transition from the open range to small farms and ranches. The raising of feed for live stock requires much of the attention of the farmer, and the growing of money crops, such as wheat, is of less importance here than elsewhere. These factors influence to a great extent the possible future production of durum wheat in this area. At present the production is very small compared with that in the eastern portion of the Dakotas.

Much of this portion of the Great Plains was settled when the difference in price of durum and common wheat was greatest, in many cases sufficient to more than offset the advantage in yield of durum over spring common wheat. The strong dislike to growing wheat with long, stiff beards, such as are present on durum wheat, also often outweighed what was then considered a questionable gain from higher yields but lower prices. The difficulty of obtaining reliable seed at a reasonable price when wanted has often prevented the growing of durum wheat. These are probably the main reasons for the relative unimportance of durum wheat in some districts where it is undoubtedly superior to spring common wheat and where winter wheat can not be successfully grown.

Durum-wheat production in the future depends (1) upon the extension of wheat as a money crop in the Great Plains area; (2) upon the extent to which winter wheat will take the place of spring wheat; and (3) upon the comparative prices of common and durum wheat.

YIELDS.¹

Experimental tests to determine the yield of durum wheat as compared with common wheats have been conducted by the Depart-

¹ Most of the data on yields presented in figure 3 and discussed herein were obtained from cooperative experiments of the Office of Cereal Investigations. Those for Hays, Kans., are from unpublished records of the Office of Dry-Land Agriculture, which kindly permits their use. Published results from the State experiment stations were used for the following places:

Nebraska, North Platte.—W. P. Snyder and W. W. Burr, "Growing crops in western Nebraska," Nebraska Experiment Station Bulletin 118.

South Dakota, Brookings.—Clifford Willis and W. L. Burlison, "Progress in wheat investigations," South Dakota Experiment Station Bulletin 128.

North Dakota, Edgeley.—O. A. Thompson, Annual Reports, Edgeley Experiment Sub-station, 1903 to 1910.

North Dakota, Fargo.—J. H. Shepperd and O. O. Churchill, "Cereal crop experiments," North Dakota Experiment Station Bulletin 75.

North Dakota, Langdon.—E. D. Stewart, Annual Reports, Langdon Experiment Sub-station, 1909, 1910, 1911.

Montana, Billings, Forsyth, Glendive, Great Falls, and Harlem.—Alfred Atkinson and J. B. Nelson, "Dry-farming investigations in Montana," Montana Experiment Station Bulletin 83.

ment of Agriculture and the State experiment stations for several years in areas where it was thought that durum wheat might be adapted. In general, the duration and agreement of the tests are sufficient to permit the drawing of certain definite conclusions.

Figure 3 shows graphically the comparative yield of durum and spring and winter common wheats at a number of stations in the

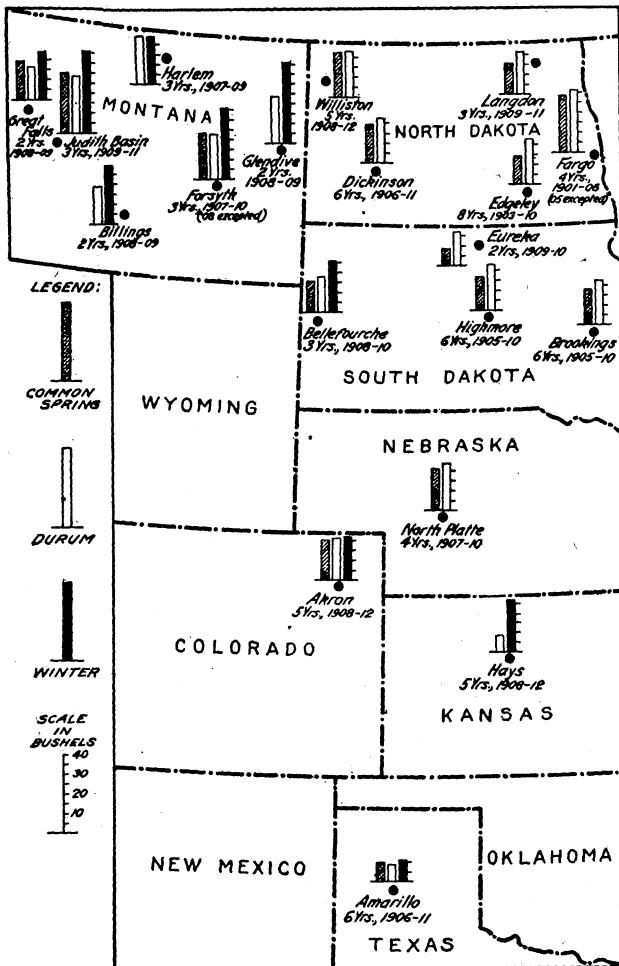


FIG. 3.—Comparative yields of durum and spring and winter common wheats at 19 field stations in the Great Plains area.

Great Plains area. Owing to differences in the duration and method of the experiments, the results at one station should not be directly compared with those at another.

As shown by figure 3, durum wheat has its greatest advantage in central and eastern North Dakota and South Dakota, where the

largest acreage is now grown. Eight years' results at Edgeley, N. Dak., and six years' results at Highmore, S. Dak., show that the best durum varieties produce on an average from 40 to 50 per cent more grain than is obtained from the standard Fife and Bluestem varieties. The difference is much greater in dry seasons, to which the durum wheat is better adapted than is the common wheat.

Taking this section as a center, the advantage of durum over common spring wheat decreases in a general way as one goes outward. In extreme eastern North Dakota and South Dakota and in western Minnesota, which constitute the more humid part of the durum-wheat area, a gain of from 15 to 25 per cent for durum wheat can usually be obtained. In dry years, or when rust is prevalent, the yield of durum wheat is often double that of the standard common varieties. However, the growing of durum wheat in this area is always at the risk of a deterioration in quality of the grain, which is almost certain to occur in wet seasons. This fact must be considered in determining the final value of durum wheat for this area.

Northward toward the Canadian boundary the advantage of durum wheat becomes gradually less, though it still outyields the common wheats. The temperature and evaporation decrease to the north, which makes the conditions more favorable for the production of common wheats. In Canada, Fife and other common wheats are considered better than durum wheat.

In western North Dakota and South Dakota the results show a gain in yield for durum wheat of about 15 per cent as compared with spring common wheat. The tests in Montana, all of which are of short duration, show that durum wheat outyields the standard varieties of Fife and Bluestem spring common wheats, but has been exceeded slightly by two new varieties, the Ghirka and the Galgalos. At the Amarillo station in the Texas Panhandle, the Galgalos has also outyielded durum wheat.

As previously stated, winter wheat is more profitable than durum wheat wherever it can be successfully grown throughout the western part of the Great Plains area. In western North Dakota, fall-sown wheat generally winterkills. In western South Dakota and eastern Montana, tests of short duration indicate an advantage for winter wheat in certain sections. From western Nebraska and eastern Colorado southward, winter wheat has given uniformly better results than any spring wheat. (See fig. 3.) The advantage of winter wheat is greatest in central and western Kansas and Oklahoma.

Throughout this area, when the soil is too dry to permit the sowing of winter wheat with safety or when a stand is destroyed by winter-killing or some other cause, durum wheat may be grown to advantage. It should not be used, however, to reseed a field of winter

wheat which is only partially killed, as the resulting mixture is more objectionable on the market than a mixture of spring and winter common wheat.

COMPARATIVE VALUE.

The market value of durum wheat, as of other classes, depends upon supply and demand. In the United States until very recently durum wheat has sold for less than have equal grades of common wheat. When introduced it was thought the principal demand would come from American and foreign mills engaged in the manufacture of macaroni, and little or no attention was given the possibility of utilizing the flour for bread making. Soon after its introduction attention was called to the suitability of durum flour for

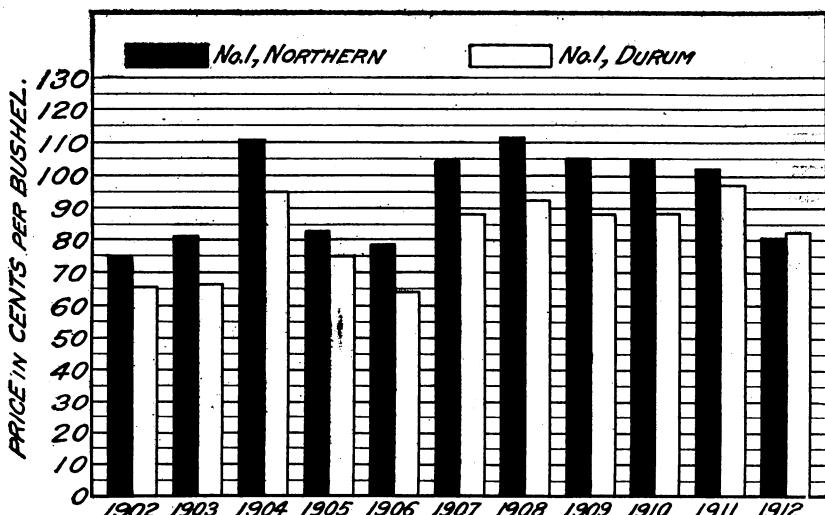


FIG. 4.—Comparative prices of No. 1 durum and No. 1 northern wheats at Duluth, Minn., on December 1, for the years 1902 to 1912, inclusive.

this purpose and its use was strongly encouraged. The development of a market has been slow, due mainly to opposition on the part of the millers. However, the use of durum flour has constantly increased, especially for blending with flour from softer wheats. American-grown durum wheat is now being utilized to a large extent for this purpose, both in this country and in Europe. The present demand is due mainly to this fuller appreciation of the value of durum wheat.

The first quotations for durum wheat on the Duluth market were in 1902, the price for the crop of that year ranging about 5 to 10 cents below equal grades of common spring wheat. Figure 4 shows that up to 1911 the difference in price has usually been greater than

that amount. The difference at primary markets and at other times of the year was often greater than shown in the diagram. Beginning with 1908 there has been a steady increase in value as compared with common wheat. The change was small in 1909 and 1910, but beginning with January, 1911, the rise has been rapid, with few downward fluctuations, reaching the highest point in 1912 with a premium over the best grades of hard common wheats.¹ This seems to indicate a more permanent change in price levels than would be the case if the rises alternated with frequent and sudden drops.

The market value of durum wheat compared with common wheat in countries where it is widely grown has been pointed out in a previous publication² of this Department. The trend of prices in this country lends special interest to the subject at this time. It has been shown, for example, that at least 80 per cent of the best bread consumed in Russia is made from Kubanka durum flour, where this wheat commands a higher price than the hard common wheats of that country either for local consumption or export. It is of interest to note that durum wheat in Russia is still at a premium over common wheat, the price often being as much higher as it has been lower in this country. This is not due to a difference in the quality of wheat from the two countries, since Russia raises common wheat fully equal to that produced in the United States and durum wheat that is no better than ours.

Both durum wheat and the flour made from it contain a larger proportion of nitrogenous or muscle-building substances. It is usually conceded that the bread made from durum flour, or from blends with other flours, is both highly nutritious and palatable. Durum wheat weighs more to the measured bushel than similar grades of common wheat, but requires more power in grinding, as it is considerably harder than common wheat. A like difference in hardness exists between soft winter wheats and the hard spring common wheats of the Northwest, yet no miller discriminates against the latter on this account. All available data indicate that durum wheat has a value at least equal to that of the best grades of common wheat.

USES.

Durum wheat is used chiefly in the manufacture of a coarse granulated flour called semolina and of ordinary flour for bread making.

¹ The premium of durum wheat over hard spring common wheat has steadily increased from the value given on December 1, 1912, as shown in figure 4. On April 15, 1913, No. 1 durum sold on the Minneapolis market at a premium of 6½ cents over No. 1 northern, and on the Duluth market at a premium of 8½ cents over No. 1 northern.

² Carleton, M. A., and J. S. Chamberlain. The commercial status of durum wheat, U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 70, pp. 10-12, 1904.

The flour is employed either alone or in blends with other flours. This wheat has also a limited use for cereal breakfast foods and during years of large production and low price has often been used for stock feeding. From semolina, the edible pastes, such as macaroni and spaghetti, are made. The consumption of these products has increased greatly during the past two decades, both at home and abroad. Until recently the quantity consumed in the United States was entirely imported, but the increasing demand has attracted manufacturers and at present about 100,000,000 pounds of macaroni are made annually from home-grown durum wheat. This quantity supplies only about one-half the demand for this product. The industry is growing rapidly, however, and the products are being widely advertised as "the best in the world," "made in America from American-grown wheats," etc. While these products have wide use, the demand is small compared with that for bread.

Experimental evidence has shown that the best varieties of durum wheat, such as the Kubanka and Arnautka, yield as high a percentage of flour as do the best common wheats, although the percentage of high-grade flour is less. The percentage of shorts is greater, while that of bran is less from durum than from common wheat. The hardness of the durum kernel increases the cost of milling. Millers have estimated the cost of grinding to be 15 cents a barrel more than for hard common wheat. The baking qualities of durum flour are high. It contains more crude protein than do the flours from other classes of wheat. The color of durum flour is yellower than that from other wheats, and by some people this color is held to be objectionable.

When baking with durum flour the only difficulty experienced is that the dough is sticky and less easy to handle. It is not otherwise difficult to make good bread from this flour. The bread is yellower in color and the volume of the loaf is less, but the absorption or strength of the durum flour is in most instances higher than that of common wheat flours. This results in more loaves from a barrel of flour. The consensus of opinion is that the bread has as good, if not better, flavor than bread from common wheat flour, for it has a distinct nutty taste and is slightly sweeter. Bread from durum flour holds moisture better than that from other flours.

Durum flour is of great value in blends and its use for this purpose is increasing. Excellent results in bread making are obtained by blending this flour with flours from spring wheat, hard winter wheat, and soft winter wheat. The successful blend does away with the stickiness of the dough, lightens the color, and increases the volume of the loaf.

CULTURE.

The culture of durum wheat differs in no way, except possibly in the rate of seeding, from that of other spring wheats in the same area. Durum wheat tillers less than spring common wheat, and the kernels are larger, so that with the drill set to seed at the same rate a thinner stand will be obtained. On the other hand, durum wheat produces more kernels to each head, which at least partially makes up for the thinner seeding. A common practice is to seed about 1 peck heavier than is usual with common wheat, though some seed at the same rate. The best rate of seeding depends largely upon the local conditions of soil, moisture, and seed bed. With good seed and favorable conditions, from 3 to 5 pecks per acre will give the best average results.

IMPROVEMENT OF THE CROP.

The expansion of the durum-wheat industry depends in part upon a continued effort for the improvement of the crop, both in yield and in quality. Further importations may prove of value, but the work already accomplished has shown the superiority of certain varieties and their adaptation to distinct sections. As a rule, farmers will find it to their advantage to grow only those varieties which have proved to be the best. It is very seldom that new varieties offer any advantages. Pure seed of the best variety should be obtained and kept as pure as possible. If thorough cleaning and grading of the seed is practiced each year the yield and quality of the crop will be maintained. Enough of this seed should be carried over from year to year to guard against its complete loss in case of crop failure. Good home-grown seed is usually better and much safer than that of unknown or distant origin. Durum-wheat seed should not be allowed to become mixed with the common wheat, as such mixtures are very objectionable to the millers and result in materially reduced prices for the crop.

